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In re patent application of

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For: HEAT EXCHANGER UNIT, IN PARTICULAR FOR A MOTOR VEHICLE AND METHOD FOR PRODUCING SAID UNIT

TRANSLATOR'S DECLARATION

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Heat exchanger unit, in particular for a motor vehicle, and method for producing said unit

The invention relates to a heat exchanger unit, in particular for a motor vehicle, having tubes and fins for the transfer of heat, and having at least one side part. Furthermore, the invention relates to a process for producing a side part.

A heat exchanger unit of this type is known, for example, from DE 197 53 408 A1 in the name of the Applicant. The heat exchanger described therein comprises a fin/tube block having a multiplicity of corrugated fins and tubes which are connected to one another in the style of a mesh structure. To stabilize the fin/tube block in particular during a manufacturing process, it is enclosed by two side parts on opposite sides. For strength reasons, a side part of this type, when seen in cross section, has an approximately U-shaped profile, resulting in a considerable saving on material compared to a solid side part. The approximately U-shaped profile is in this case formed by deforming edge regions of a sheet-metal strip, the width of which results from the sum of the lengths of the two limbs of the U profile and the width of the side part. The two U-limbs then act, as it were, as reinforcing fins by preventing undesired deformation of the side part. For improved distribution of thermal stresses during operation of the heat exchanger, these reinforcing fins may have expansion regions which are formed as fold-like beads.

It is an object of the invention to provide a heat exchanger unit having at least one side part and a

production process allowing additional savings on material to be made.

This object is achieved by a heat exchanger unit having the features of claim 1. According to claim 1, a heat exchanger unit comprises at least one heat exchanger. The heat exchanger unit may also comprise two, three or more heat exchangers. The heat exchanger unit has tubes through which at least one first medium can flow and around which a second medium can flow, so that heat transfer from the at least one first medium to the second medium or vice versa is possible. To increase the heat-transfer surface area, heat-transfer fins which are in thermal contact with the tubes are arranged between the tubes.

On at least one side, the heat exchanger unit has a side part which comprises a baseplate that bears against an outermost tube or an outermost fin. In particular during a production process, for example a soldering process, it is desirable for the at least one side part to stabilize a tube/fin block formed by the tubes and heat-transfer fins. For this reason, the side part has at least one reinforcing fin. It is preferable for the side part to have two or more reinforcing fins.

The object of the invention is advantageously achieved by virtue of the fact that at least one reinforcing fin is formed by a deformed center piece of the surface of the baseplate of the side part. For this purpose, during production of the side part an edge of the center piece of the surface is precut in sections, after which the center piece of the surface is deformed out of the plane of the baseplate. Unlike with a previously known side part, in which reinforcing fins are formed from deformed edge regions of the surface of a baseplate, to produce the side part according to the invention it is possible to use a sheet-metal strip whose width corresponds to the width of the baseplate.

This results in an advantageous saving on material, which brings with it a reduction in the materials costs of the heat exchanger unit.

Preferred embodiments of the invention form the subject matter of the subclaims.

According to an advantageous refinement, at least one reinforcing fin runs in a longitudinal direction of the side part. This results in stiffening of the side part in said longitudinal direction. In another embodiment, at least one reinforcing fin runs in a transverse direction of the side part, so that the side part is stiffened in the transverse direction.

According to a preferred embodiment, at least one of the reinforcing fins is provided with at least one securing means. It is particularly preferable for the securing means to be formed by a deformed reinforcing fin or by a deformed part of a reinforcing fin. This allows further devices, for example a drier, to be secured to the heat exchanger unit without additional outlay on material. It is also conceivable to use securing means which can be used to mount the heat exchanger unit in an engine compartment of a motor vehicle.

According to a preferred embodiment, the side part has at least one expansion section. The expansion section is formed by one or more apertures and a plurality of webs adjoining the apertures, the apertures advantageously being flush with one another. At least one aperture has in this case been formed by deformation of a center piece of the surface out of the plane of the baseplate and therefore corresponds to the center piece of the surface in question. This means that a reinforcing fin and a corresponding aperture in each case adjoin one another.

It is particularly preferable for the webs to have fold-like beads. This results in particularly high expandability of the side part in the region of the expansion section formed by the apertures and webs.

The object of the invention is also achieved by a process for producing a side part as described in claim 9. A basic idea of the invention is to use an areal metal sheet whose dimensions do not exceed a baseplate of the subsequent side part when producing the side part, so that material can be saved compared to previously known production processes. Reinforcing fins are formed from existing pieces of the surface of the metal sheet. For this purpose, in each case one edge of a piece of the surface is precut in sections, after which the piece of the surface is deformed out of a plane that is predetermined by the metal sheet.

In the text which follows, the invention is explained in detail on the basis of exemplary embodiments and with reference to the drawings, in which:

Fig. 1 shows a perspective view of a side part,

Fig. 2 shows a cross-sectional illustration of a side part,

Fig. 3 shows a plan view of two metal sheets,

Fig. 4 shows a perspective view of a heat exchanger,

Fig. 5 shows a perspective view of a heat exchanger unit,

Fig. 6 shows a perspective view of a side part,

Fig. 7 shows a perspective view of a side part,

Fig. 8 shows an excerpt from a side part, and

Fig. 9 shows an excerpt from a side part.

Fig. 1 and Fig. 2 illustrate a perspective view and a cross section, respectively, of a side part 100; identical features are provided with the same reference symbols in both figures. The side part 100 comprises a baseplate 110 and two reinforcing fins 120 and 130. The reinforcing fins 120, 130 comprise center pieces of the surface of the baseplate 110 which have been deformed out of the plane of the baseplate 110. By way of example, the rectangular center piece 120 of the surface has for this purpose been cut out at three edges 140, 150 and 160 and bent along an edge 170, in such a manner that the center piece 120 of the surface is approximately perpendicular to the baseplate 110. This "raising up" of the center piece 120 of the surface causes an aperture 180 to be left behind in the baseplate 110. Furthermore, the reinforcing fins 120, 130 have apertures 190, 200 which are provided for the purpose of receiving pins (not shown), the pins, together with clamping straps (likewise not shown), serving as a clamping device for heat exchanger manufacture.

In a further exemplary embodiment (not shown), the heat exchanger, during its manufacture, in particular during a soldering process, is held together not by clamping straps but rather with the aid of what is known as a clamping cage. The pins for holding the clamping straps are then no longer required, and there are also no corresponding apertures.

Fig. 3 compares a sheet-metal strip 300 for producing a side part for a heat exchanger in accordance with the prior art and a sheet-metal strip 400 for producing a side part in accordance with the present invention. The side parts which are to be produced from the sheet-metal strips 300, 400 should in this case each have a

width b and reinforcing fins with a height H. The sheet-metal strip for this purpose has a width b + 2 h, with a baseplate of the subsequent side part being formed by a central region 310 of width b. Edge regions 320 and 330 are deformed out of the plane of the drawing shown in Fig. 3 along the deformation edges 340 and 350, respectively, illustrated by dashed lines, and serve to form reinforcing fins for the subsequent side part. Furthermore, the sheet-metal strip 300, which has already been pre-stamped, has an extension 360 which is intended for connection to a water tank.

By contrast, the full width b of the sheet-metal strip 400 forms the baseplate 410 of a subsequent side part. To form reinforcing fins, center pieces 420 and 430 of the surface of the baseplate 410 are cut out along the edges 440, 450 and 460, 470, respectively, and are deformed out of the plane of the drawing shown in Fig. 3 along the deformation edges 480 and 490, respectively. The width h of the center pieces 420 and 430 of the surface in this case corresponds to the height of the subsequent reinforcing fins. Like the sheet-metal strip 300, the pre-stamped sheet-metal strip 400 also has an extension 495 for connecting the subsequent side part to a water tank.

This comparison makes it clear that a heat exchanger having a side part in accordance with the present invention can be produced at lower materials costs than a heat exchanger having a side part in accordance with the prior art. There is no need to do without any significant functional features, such as for example the width of the baseplate which is available for covering heat-transfer fins or the stiffening provided by reinforcing fins.

Fig. 4 shows, as an exemplary embodiment, a coolant radiator 500 for use in a motor vehicle. The coolant radiator 500 has a tube/fin block 510 comprising tubes

520 and corrugated fins 530. The ends of the tubes 520 open out into collection tanks 540 and 550 on two opposite sides of the tube/fin block 510. The collection tanks 540 and 550 are closed off on their end sides 555 and 558, respectively. The collection tanks 540 and 550 have an inlet opening 560 and an outlet opening 570 for supplying and discharging the coolant. In particular to protect the outermost corrugated fin 580, the tube/fin block 510 is surrounded by side parts 590 on both sides. The coolant radiator functions in the following way. The coolant coming from an internal combustion engine of the motor vehicle flows through the inlet opening 560 into the water tank 540, where it is distributed between the tubes 520. After it has flowed through the tube/fin block 510, the coolant is collected in the water tank 550 and returned to the coolant circuit of the motor vehicle through the outlet opening 570. To cool the coolant, ambient air is passed through the tube/fin block 510 in such a manner that the cooling air flows around the tubes 520 and the fins 530. The corrugated fins 530 serve to increase the heat-transfer surface area and are soldered to the tubes 520 for improved heat transfer.

To prevent the tube/fin block 510 from falling apart during the soldering process, it is necessary for the tubes 520 and the fins 530 to be clamped in place. This is realized using what are known as clamping straps. The tubes, fins and side parts may also equally well be clamped in place with the aid of a clamping frame or clamping cage which bears against the side part. To protect against undesired deformation, the outermost corrugated fin 580 is covered with the aid of the side part 590 during the clamping operation, i.e. including during the soldering process. For reinforcement against undesired deformation, the side part 590 is for its part provided with reinforcing fins 600 and 610. These reinforcing fins 600, 610 are formed by deformed center

pieces of the surface of a baseplate 620 of the side part 590, resulting in savings on material and therefore on costs.

As a refinement to the above exemplary embodiment, Fig. 5 shows a heat exchanger unit 700, comprising two heat exchangers, namely a coolant radiator 710 and a condenser 720. The structure and functioning of the coolant radiator 710 does not differ significantly from the coolant radiator shown in Fig. 4, and consequently will not be described in detail here. The condenser 720 likewise substantially comprises two collection tanks 730 and 740 and a tube/fin block which is located between them, cannot be seen in this figure and connects the collection tanks 730 and 740, which are designed as collection tubes, to one another. The condenser 720 is arranged next to the coolant radiator 710, in such a manner that cooling air first of all flows through the condenser 720 and then immediately afterward flows through the coolant radiator 710. The condenser 720 serves to cool a refrigerant of an air-conditioning circuit, with the refrigerant being condensed in the condenser. The tubes 750 of the coolant radiator, as seen in the main direction of flow of the cooling air, are arranged aligned behind the tubes of the condenser, so that common, continuous corrugated fins 760 can be used. Accordingly, the corrugated fins 760 extend from an inflow side of the condenser to an outflow side of the coolant radiator.

To protect the outermost corrugated fin 770 there is a side part 780 which likewise extends from the inflow side of the condenser to the outflow side of the coolant radiator. The side part 780 is stiffened by two reinforcing fins 790 and 800, the reinforcing fins 790 and 800 being formed from center pieces of the surface of a baseplate 810 of the side part 780. On an opposite side of the heat exchanger unit 700 from the side part 780 there is likewise arranged a side part, although

only one side edge 820 of that side part can be seen in Fig. 5. The common tube/fin block 830 of coolant radiator 710 and condenser 720 can therefore be pre-clamped from both sides in a single working step using the common side parts 780 and 820 and can then be soldered in a further working step.

In further exemplary embodiments (not shown), the heat exchanger unit comprises a high-temperature cooler and a low-temperature cooler, or an oil cooler and a condenser, with the oil cooler if appropriate being a transmission oil cooler. Other combinations comprising any desired heat exchangers are equally possible.

Furthermore, it is possible to provide heat exchanger units comprising three or more individual heat exchangers with one or more, preferably two, side parts according to the invention; once again, any desired heat exchangers are suitable for use as the individual heat exchangers.

Fig. 6 shows a further example of a side part 900 which comprises a baseplate 910 and reinforcing fins 920, 930 and 940. The reinforcing fins 920, 930 and 940 correspond to apertures 950, 960 and 970, respectively, which correspond precisely to the center pieces of the surface of the baseplate 910 from which the reinforcing fins 920, 930 and 940 have been formed by deliberate deformation. The deformation may be carried out in parallel, as in the case of the reinforcing fins 920 and 930, or in antiparallel, as in the case of the reinforcing fins 930 and 940. Clamping pins (not shown) can be guided through apertures 980, 990 and 1000, in a similar manner to the exemplary embodiment shown in Fig. 1, so that a heat exchanger unit which includes the side part 900 can be clamped by means of clamping straps (likewise not shown) during a manufacturing process.

In a further exemplary embodiment (not shown), the heat exchanger is held together during its production, in particular during a soldering process, not by clamping straps but rather with the aid of what is known as a clamping cage. The pins for holding the clamping straps are then no longer required, and there are also no corresponding apertures.

Fig. 7 shows a perspective view of a side part 1100 for a heat exchanger unit (not shown) with two different heat exchangers. The side part 1100 has an expansion section 1125 between a region 1110 which is assigned to a first heat exchanger and a region 1120 which is assigned to a second heat exchanger. The expandability in the expansion region 1125 is provided by means of apertures 1130, so that the regions 1110 and 1120 are only connected to one another by webs 1140, the webs 1140 being configured in bent form in order to improve the expandability. The apertures 1130 correspond to reinforcing fins 1150 which are formed by cutting out center pieces 1130 of the surface on in each case three sides and then deforming these center pieces along a respective fourth side edge, out of the plane of a baseplate 1155 of the side part 1100. In addition, the side part 1100 is stiffened with the aid of further reinforcing fins 1160 and 1170, the reinforcing fin 1170 furthermore having holders 1190 with securing eyelets 1200. The reinforcing fins 1160 and 1170, unlike the reinforcing fins 1150 formed by deformed center pieces of the surface of the baseplate 1155, are formed by deformed edge pieces of the surface of the baseplate 1155 of the side part 1100.

Furthermore, at its ends the side part 1100 has extensions 1210 and 1220, which serve to cap water tanks (not shown) of one of the two heat exchangers of a heat exchanger unit (not shown) for which the side part 1100 is provided. To reduce mechanical loads, for example caused by thermal stresses, the side part 1100

has two expansion regions 1230 and 1240, which are substantially formed by apertures 1250 and 1260, respectively.

In a further exemplary embodiment (not shown), the apertures 1250 and 1260 correspond to reinforcing fins which directly adjoin the apertures 1250 and 1260 and are formed by deforming center pieces of the surface of the baseplate 1155 of the side part 1100, with the cutouts 1250 and 1260 having been formed precisely by deformation of these center pieces of the surface.

Fig. 8 shows an excerpt from a side part 1300 with various reinforcing fins 1310 and 1320 and corresponding cut-out center pieces 1330 and 1340 of the surface. The reinforcing fins 1310 run in the longitudinal direction of the side part 1300 and have apertures 1350 for a clamping pin, while the reinforcing fins 1320 run at an angle α with respect to the longitudinal direction of the side part 1300 and do not have apertures. In principle, the reinforcing fins 1320 can likewise be provided with apertures for clamping pins.

The reinforcing fins 1320 run at an angle α of approximately 10° with respect to the longitudinal direction of the side part, resulting in a favorable geometry of the reinforcing fins, in which four reinforcing fins lie next to one another in regions 1360, resulting in a particularly high stability of the side part 1300 at least in these regions 1360. In other exemplary embodiments, the angle α may be between 0° and 90° as desired.

Fig. 9 illustrates an excerpt from a side part 1400 in which a reinforcing fin 1410 is formed by incisions 1420, 1430 being precut out of a planar metal sheet, which incisions, together with an edge 1440 of the metal sheet, define a surface piece which is bent out

of the plane of the metal sheet through an angle of approximately 90° in the direction indicated by arrow 1450.

In particular in the region of the bending edge 1460, the angle may also be less than 90°. This applies to all side parts and heat exchanger units according to the invention.